refKanj2006

In this paper, the technique of Mixed Importance Sampling is presented in order to quickly and efficiently model SRAM yield. Monte-Carlo simulations are the current standard that has been used to try to estimate fail probabilities. However, to have a high confidence for a probability of low failure, then many Monte-Carlo simulations need to be run. These simulations will take too long to run. Mixed Importance Sampling samples in the tails of the distribution instead of wasting time sampling around the mean of the distribution. This is achieved by mathematically shifting the into the tail of the distribution.

Their claim is that using this method that they were able to reach the same failure probability with the same confidence in a much quicker time. They saw over a 100X speed up in their simulation times.

ref Mukhopadhyay2005

This paper probabilistically models the failures of a SRAM bit cell. They then use these probabilities to optimize the bit cell design in order to improve the overall yield of a chip. The four SRAM failures that were looked at where destructive reads, unsuccessful writes, access time failures, and hold failures. Probability equations were derived for both long channel devices as well as short channel devices. Because of ease to model, the long channel probabilities were used, and were proven to be fairly accurate.

They next modeled the effects of transistor sizing on their failure probabilities. Through these models they were able to create an algorithm that would optimize a design to minimize the probability of failing. Using this algorithm they claimed to be able to take a design that had an original yield of 47% and increase the yield of that design to 95%.

refKhalil08

In this paper a way to estimate the dynamic cell stability is introduced. Some of the current problems with current approaches are they do not capture the transient behavior, and MC analysis isn't reliable in the tail region, which is the important region when talking about failure probability. In this paper they propose to use a technique that is used commonly in other Engineering fields; most probable failure point. The criteria used for their failure probability is dynamic stability instead of static stability methods. This is done because static estimations over estimate the noise margins.

There results show that their model using the dynamic stability estimation, they were able to optimize the SRAM to have stability improvements, these changes were not noticed in the standard static estimation because they didn't take into account the transient behavior.

regAgarwal2006

As with the prior papers, mentions how variations is shown to be a limiting factor in SRAM do to their effects on RNM and WNM. Monte-Carlo simulations are once again mentioned as being the typical way to analyze electric yield, but due to the large number of simulations needed, is highly prohibitive. This paper proposed stability criteria for Read, Write and Read Access failure probabilities as linear functions of independent sources of variation. These three criteria were modeled into one density function.

Their models were verified using simulations of industrial 65nm SOI technology and were compared with a Monte-Carlo simulation of 500,000 runs. Their results matched well with the traditional MC analysis.

refSinghee2007

This paper proposes a technique very similar to the first paper discussed. Their goal is to also simulate points that are in the tails region as opposed to regions that are around the mean of the distribution. To do this they use mathematics, specifically the extreme value theory in order to build what they call ther classifier. The classifier only allows specific samples to be simulated. Once the classifier is built, samples are generated using standard Monte-Carlo process, however the classifier only allows samples from tail regions to be simulated, blocking samples around the mean from simulating.

There proposed process also has improved speed up in simulation times of 10X-100X over the standard MC simulations.